Age and Geochemistry of Ore-Related Intrusions in the Zhonggu Ore Field, Middle-Lower Yangtze Metallogenic Belt

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The Zhonggu ore field is in the southern part of the Ningwu volcanic basin, the largest iron ore district in the Middle-Lower Yangtze River Metallogenic Belt (MLYRMB) of eastern China. This area has produced more than 2,000 Mt of iron ore, but very few Cu-Au deposits have been reported. The age of mineralization and associated intrusions remain unclear in this area. Our study focuses on one iron deposit and six intrusions that are associated with main iron deposits in the Zhonggu ore field. The intrusions include the Gushan porphyritic gabbrodiorite, Longshan gabbrodiorite, Hemushan diorite, Baixingshan diorite, Zhongjiu diorite, and Taipingshan monzonite. These intrusions are geochemically medium- to high-K calc-alkaline or shoshonitic, with the former dominant. Laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) zircon U-Pb dating yielded ages of 132.6 ± 1.6 to 131.6±1.6, 130.7±2.2 to 129.4±1.9, 131±2.0, and 132.3±2.1 Ma for intrusions associated with the Longshan, Taipingshan, Baixiangshan, and Zhongjiu deposits, respectively, indicating that these intrusions were emplaced in the Early Cretaceous (132.6–129.4 Ma). Phlogopite intergrown with magnetite in the Longshan deposit was dated by $^{40}Ar/^{39}Ar$ method at 132.26±0.87 Ma, which is slightly younger than the associated intrusion. This magmatism and mineralization was contemporaneous with the second stage (135–127 Ma) of magmatic activity and mineralization documented elsewhere in the MLYRMB. The mineralized intrusions associated with the Zhonggu iron ore field have similar chondrite-normalized rare earth element (REE) and primitive mantle-normalized multi-element variation patterns, which are characterized by the enrichment of light REE and large ion lithophile elements (LILE) and the depletion of heavy REE and high field strength elements (HFSE). These intrusions have total REE concentrations that are consistent with evolution of the magma from mafic-intermediate to felsic. The intrusions are thought to be derived from partial melting of enriched mantle, with contamination of continental crustal or lithospheric materials during magma ascent. The magmatism in the Zhonggu iron ore field was formed during Early Cretaceous in a lithospheric thinning and extension setting. The arc affinities of the intrusions in this region indicate their formation was possibly associated with subduction of the Paleo-Pacific Plate, a process that was probably the main factor in generating the mineralization in the MLYRMB. The iron mineralization-related intrusions in the study area are also distinctly different from intrusions associated with Cu-Au mineralization, probably due to differences in the involvement of slab-derived fluids in generating the source magmas. This research highlights the exploration potential of this region, indicating that the 132 to 129 Ma monzonites and diorites should be considered prime targets for Fe exploration but are unlikely to be related to Cu-Au deposits.